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# Increased blood loss in upright birthing positions originates from perineal damage

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**Objective** To assess whether the risk of severe blood loss is increased in semi-sitting and sitting position, and if so, to which extent blood loss from perineal damage is responsible for this finding.

**Design** Secondary analysis of data from a large trial.

**Setting** Primary care midwifery practices in the Netherlands.

**Population** About 1646 low-risk women who had a spontaneous vaginal delivery.

**Methods** Blood loss was measured using a weighing scale and measuring jug. Logistic regression analysis was used to examine the net effects of birthing position and perineal damage on blood loss greater than 500 ml.

**Main outcome measures** Mean total blood loss and incidence of blood loss greater than 500 ml and 1000 ml.

**Results** Mean total blood loss and the incidence of blood loss greater than 500 ml and 1000 ml were increased in semi-sitting and sitting position. In logistic regression analysis, the interaction between birthing position and perineal damage was almost significantly associated with an increased risk of blood loss greater than 500 ml. Semi-sitting and sitting position were only significant risk factors among women with perineal damage (OR 1.30, 95% CI 1.00–1.69 and OR 2.25, 95% CI 1.37–3.71, respectively). Among women with intact perineum, no association was found.

**Conclusions** Semi-sitting and sitting birthing positions only lead to increased blood loss among women with perineal damage.

**Keywords** Birthing positions, blood loss, perineal damage.

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## Introduction

The supine position is most commonly used for the second stage of labour in western cultures.<sup>1,2</sup> Studies have shown that women use a variety of positions if they are allowed to make their own choices.<sup>3,4</sup> Therefore, the routine use of the supine position can be considered an intervention in the normal course of labour. The evidence to support the use of this intervention is not clear.<sup>5</sup>

Several studies have compared the outcomes of labour in supine versus other positions. Two meta-analytic reviews have indicated some disadvantages of the supine position, most notably an increase in instrumental deliveries and episiotomies.<sup>5,6</sup> In addition, women have reported reduced pain in nonsupine positions and a preference for other positions in quantitative studies.<sup>7–9</sup> A qualitative study showed that women vary in their experiences with birthing positions but

having an influence on the choice of position may contribute to a better birth experience.<sup>10</sup>

The main advantage of the supine position is reduced mean blood loss and incidence of blood loss greater than 500 ml compared with other positions.<sup>5,6</sup> These differences were only found between supine and upright positions, mainly among women using the birthing chair or birthing stool. It is not clear which factors contribute to these findings.<sup>9,11</sup>

Measurement error may explain some of the differences found. The same amount of blood loss may appear to be more in upright than in recumbent position.<sup>9</sup> In most studies, estimated blood loss is used as the outcome measure.<sup>9,12–15</sup> We wanted to improve upon previous research and establish whether there is an actual increase in blood loss in sitting positions by using more accurate, objective measurements.

If there is a real difference, it is not clear whether this excess in blood loss originates from perineal damage or from the

uterus. Uterine atony is a serious cause of postpartum haemorrhage and is the second most important indication for emergency peripartum hysterectomy after placenta accreta in the Netherlands.<sup>16</sup> If there is an increase in blood loss in sitting positions, it is therefore important to establish where this originates from.

Many studies into birthing positions include women with risk factors for postpartum haemorrhage, such as oxytocin infusion, epidural anaesthesia and instrumental delivery.<sup>9,12,14,17–20</sup> Results of these studies may not apply to women in low-risk settings. We therefore performed a study among low-risk women only.

We had two main research questions. Is the risk of severe blood loss increased in semi-sitting and sitting compared with recumbent birthing positions when accurate measurements of blood loss were used? If so, to what extent is the excess risk due to blood loss from perineal damage?

## Methods

We used data from a trial into active versus physiological management of the third stage of labour (K.C. Herschderfer *et al.*, unpubl. obs.) for this secondary analysis. This trial was conducted from 1 May 1995 to 1 September 1996. Twenty independent midwifery practices with a total of 70 midwives were recruited all over the Netherlands through advertisement in the national midwifery journal and through local midwifery groups.

Independent midwives only look after women who have a spontaneous vaginal delivery at term with a single fetus in cephalic presentation either at home or in hospital. When risk factors occur, these women are referred to obstetrician-led care. Many potential confounding factors, such as oxytocin infusion, epidural anaesthesia and instrumental delivery, were therefore not present in those cases delivered by these midwives.

Exclusion criteria in the trial were defined as previous postpartum haemorrhage (blood loss more than 1000 ml), haemoglobin (Hb)  $\leq 6.0$  mmol/l, large uterine size, prolonged first stage of labour and second stage of labour of more than 90 minutes in primigravidas or more than 45 minutes in multigravidas. Women who were unable to read the Dutch language were excluded because they would not be able to answer the questionnaire used in this study.

The Medical Ethics Committee of the Netherlands Institute of Applied Scientific Research (TNO) in Leiden granted ethical approval for this trial.

The main outcome measures in our study were mean total blood loss and the incidence of blood loss greater than 500 ml and 1000 ml. The World Health Organization (WHO) has defined postpartum haemorrhage as blood loss greater than 500 ml.<sup>21</sup> In the Netherlands, this definition is restricted to cases whereby the blood loss is greater than 1000 ml.<sup>22</sup> We therefore used both cutoff points for the purpose of this

study. Blood loss was measured from the delivery of the fetus till 1 hour after the delivery of the placenta. All midwives received a digital weighing scale, a measuring jug and perineal pads to measure the blood loss accurately.

The Hb levels provided a more objective indication of the consequences of blood loss. Hb levels were measured on the fourth to sixth day postpartum and were compared with Hb levels at 36 weeks of gestation. Hb meters (HemoCue AB, Ängelholm, Sweden) were provided and checked every 2 months to the standards required for national quality control.

Position at the time of delivery was recorded as recumbent (supine or lateral), semi-sitting (supported by pillows or a bedrest) or sitting (in bed supported by a person or on a birthing stool or similar birthing aid). In the Netherlands, women rarely give birth in lateral position, and the birthing stool is most commonly used for the sitting position.

We categorised perineal damage into intact perineum and perineal damage (perineal or labial tear in need of suturing or episiotomy).

An association with an increased risk of postpartum haemorrhage has been reported in the literature for the following factors other than birthing position: maternal age,<sup>23</sup> primiparity,<sup>23,24</sup> third stage of labour longer than 30 minutes,<sup>25</sup> high birthweight,<sup>25–27</sup> perineal damage<sup>25,26</sup> and prolonged second stage of labour.<sup>25,26</sup> Active management of the third stage of labour decreases the risk of postpartum haemorrhage.<sup>15</sup> We examined the net effects of these factors on postpartum blood loss greater than 500 ml.

If the difference in blood loss was due to uterine factors, sitting positions would be significant risk factors regardless of the presence of perineal damage. On the other hand, if the difference was due to excessive bleeding from perineal damage, this would be the case among women with perineal damage only. We therefore examined the interaction between birthing position and perineal damage.

## Data analysis

We used *t* test and one-way analysis of variance for continuous variables and chi-square and Fisher's exact test for categorical variables. The Bonferroni *post hoc* test was used for multiple comparisons to reduce the risk of erroneously finding a significant difference due to multiple testing. A logistic regression analysis was used to establish the net effects.

All statistical tests were two tailed, and *P* values  $< 0.05$  were considered statistically significant. SPSS 11.5 for Windows was used for data analysis (SPSS Inc., Chicago, IL, USA).

## Results

Most of the 1646 women in the study gave birth in recumbent position followed by semi-sitting and sitting position (Table 1).

**Table 1.** Demographic and obstetric data of the population by birthing position

	All positions combined (n = 1646)	Recumbent (n = 922)	Semi-sitting (n = 605)	Sitting (n = 119)	P value
<b>Total blood loss (ml), mean [range]</b>	508 [30–2830]	480 <sup>*,**</sup> [30–2830]	538 <sup>*</sup> [40–2301]	570 <sup>**</sup> [95–1700]	0.001
>500, n (%)	633 (38.5)	322 (34.9)	251 (41.5)	60 (50.4)	0.001 <sup>***</sup>
>1000, n (%)	150 (9.1)	73 (7.9)	61 (10.1)	16 (13.4)	0.083 <sup>****</sup>
<b>Age (years), n (%)</b>					
25 years or younger	145 (8.9)	85 (9.3)	55 (9.2)	5 (4.2)	
26–30	552 (33.8)	312 (34.1)	213 (35.6)	27 (22.9)	
31–35	712 (43.6)	399 (43.6)	252 (42.1)	61 (51.7)	
36 years or older	223 (13.7)	119 (13.0)	79 (13.2)	25 (21.2)	0.019
<b>Non-Dutch origin, n (%)</b>	50 (3.0)	25 (2.7)	19 (3.2)	6 (5.0)	0.384
<b>Primiparous, n (%)</b>	640 (39.3)	336 (36.8)	251 (42.0)	53 (44.9)	0.057
<b>Duration of second stage &gt;60 minutes, n (%)</b>	211 (12.9)	104 (11.3)	81 (13.5)	26 (21.8)	0.005
<b>Duration of third stage &gt;30 minutes, n (%)</b>	120 (7.3)	66 (7.2)	43 (7.1)	11 (9.3)	0.689
<b>Active management of third stage, n (%)</b>	834 (50.7)	457 (49.6)	317 (52.4)	60 (50.4)	0.556
<b>Perineal damage, n (%)</b>	1178 (71.7)	655 (71.1)	442 (73.4)	81 (68.1)	0.405
<b>Birthweight (g), mean [range]</b>	3518 [2175–5200]	3517 [2175–4870]	3517 [2480–5200]	3534 [2640–4600]	0.915
<b>Hb level 4–6 days postpartum (g/dl), mean [range]</b>	12.00 [6.94–16.78]	12.06 [6.94–16.78]	11.95 [7.26–16.13]	11.63 [7.90–16.61]	0.010
<b>Hb level 4–6 days postpartum minus Hb level at 36 weeks of gestation (g/dl), mean [range]</b>	0.22 [–5.16 to 6.29]	0.29 [–5.16 to 6.29]	0.19 [–4.84 to 5.00]	–0.16 [–4.03 to 3.06]	0.015

Missing values are excluded.

\*Multiple comparisons (Bonferroni) mean difference –58 [–101 to –14], significant at 0.05 level.

\*\*Multiple comparisons (Bonferroni) mean difference –90 [–170 to –9], significant at 0.05 level.

\*\*\*Linear-by-linear association  $P = 0.000$ .

\*\*\*\*Linear-by-linear association  $P = 0.027$ .

The mean blood loss in the total group was 508 ml. Blood loss greater than 500 ml occurred in 38.5% and greater than 1000 ml in 9.1% of women. In semi-sitting and sitting position, the mean total blood loss was significantly greater than in recumbent position. A significant linear association was found for the following variables: the risk of blood loss greater than 500 ml and 1000 ml was greater in semi-sitting than in recumbent position and greater in sitting than in semi-sitting position.

Mean Hb level at the fourth to sixth day postpartum was lower in the semi-sitting and sitting position groups. In addition, variation was found between these groups in the difference between the postpartum Hb level and that at 36 weeks of gestation. Only the differences between recumbent and sitting position were significant.

Women in sitting positions were older than women in other positions. A higher proportion of women in sitting position had a second stage of labour longer than 60 minutes compared with women in other positions. Only 50 women were of non-Dutch origin.

The associations between various factors and blood loss are given in Table 2 for women with intact and damaged perineum.

Among women with perineal damage, semi-sitting and sitting position, primiparity and second stage of labour longer than 60 minutes were strongly associated with increased total blood loss and blood loss greater than 500 ml and 1000 ml. These associations were not found among women with an intact perineum. Equally, birthing position was linearly related to blood loss greater than 500 ml and 1000 ml among women with perineal damage but not among women with an intact perineum. Third stage of labour longer than 30 minutes and birthweight more than 4 kg were risk factors for most outcomes in women with and without perineal damage. Active management of the third stage was a protective factor.

When logistic regression analysis was performed, the interaction between sitting position and perineal damage was almost significantly related to blood loss greater than 500 ml. We therefore reported the outcomes of the logistic regression analysis separately for women with and without perineal

**Table 2.** Associations between various factors and blood loss for women with intact perineum and women with perineal damage

	Women with intact perineum (n = 464)							Women with perineal damage (n = 1178)						
	Risk factor present (n)	Blood loss >500 ml, n (%)	P	Blood loss >1000 ml, n (%)	P	Mean total blood loss (ml)	P	Risk factor present (n)	Blood loss >500 ml, n (%)	P	Blood loss >1000 ml, n (%)	P	Mean total blood loss (ml)	P
<b>Birth position</b>														
Recumbent	266	70 (26.3)		17 (6.4)		422		655	252 (38.5)		56 (8.5)		504	
Semi-sitting	160	53 (33.1)		11 (6.9)		465		442	197 (44.6)		50 (11.3)		566	
Sitting	38	12 (31.6)	0.306*	1 (2.6)	0.673**	421	0.361	81	48 (59.3)	0.001***	15 (18.5)	0.014****	640	0.001
<b>Duration of second stage labour (minutes)</b>														
More than 60	39	15 (38.5)		3 (7.7)		524		172	86 (50.0)		27 (15.7)		607	
Up to 60	424	120 (28.3)	0.182	26 (6.1)	0.726	429	0.067	1002	409 (40.8)	0.024	93 (9.3)	0.010	525	0.005
<b>Birthweight (kg)</b>														
More than 4	55	24 (43.6)		5 (9.1)		545		155	94 (60.6)		32 (20.6)		706	
Up to 4	408	111 (27.2)	0.012	24 (5.9)	0.370	422	0.006	1019	402 (39.5)	<0.001	88 (8.6)	<0.001	510	<0.001
<b>Management of third stage of labour</b>														
Active	243	59 (24.3)		11 (4.5)		412		589	216 (36.7)		43 (7.3)		485	
Physiological	221	76 (34.4)	0.017	18 (8.1)	0.108	463	0.074	589	281 (47.7)	<0.001	78 (13.2)	0.001	589	<0.001
<b>Duration of third stage of labour (minutes)</b>														
More than 30	46	27 (58.7)		12 (26.1)		705		73	46 (63.0)		18 (24.7)		678	
Up to 30	416	108 (26.0)	<0.001	17 (4.1)	<0.001	407	<0.001	1098	448 (40.8)	<0.001	102 (9.3)	<0.001	527	<0.001
<b>Maternal age (years)</b>														
25 years or younger	50	16 (32.0)		1 (2.0)		414		95	41 (43.2)		11 (11.6)		536	
26–30	153	42 (27.5)		7 (4.6)		419		398	169 (42.5)		54 (13.6)		563	
31–35	183	48 (26.2)		14 (7.7)		429		529	220 (41.6)		38 (7.2)		510	
36 years or older	77	28 (36.4)	0.375	7 (9.1)	0.268	501	0.239	145	62 (42.8)	0.986	17 (11.7)	0.014	566	0.112
<b>Parity</b>														
Primiparous	133	42 (31.6)		7 (5.3)		438		507	249 (49.1)		66 (13.0)		581	
Multiparous	328	91 (27.7)	0.410	22 (6.7)	0.563	434	0.896	659	244 (37.0)	<0.001	55 (8.3)	0.010	504	<0.001

\*Linear-by-linear association,  $P = 0.186$ .\*\*Linear-by-linear association,  $P = 0.659$ .\*\*\*Linear-by-linear association,  $P = 0.000$ .\*\*\*\*Linear-by-linear association,  $P = 0.006$ .

damage. In Table 3, variables that were significantly related to the outcome are shown. More details are available from the first author on request. Birthweight was linearly related to the log-odds of blood loss greater than 500 ml and was therefore included as a continuous variable. Maternal age was not and was included as a categorical variable.

In the group with perineal damage, semi-sitting and sitting positions were significantly associated with an increased risk of blood loss greater than 500 ml (OR 1.30 and OR 2.25, respectively). Among women with an intact perineum, this association was not found. Other significant factors in both groups were birthweight, active management of the third stage of labour and third stage longer than 30 minutes. Among women with perineal damage, primiparity was also a significant factor.

## Discussion

In this study, mean total blood loss and the incidence of blood loss greater than 500 ml and 1000 ml were increased in semi-sitting and sitting positions. These positions were only significant risk factors among women with perineal damage and not among women with intact perineum.

**Table 3.** Multiple logistic regression of predictors of blood loss >500 ml in women with intact perineum and women with perineal damage\*

Predictor variable	Intact perineum, <i>N</i> = 457, >500 ml ( <i>n</i> = 133) OR (95% CI)	Perineal damage, <i>N</i> = 1153, >500 ml ( <i>n</i> = 487) OR (95% CI)
<b>Birthing position</b>		
Recumbent	1.0 (reference)	1.0 (reference)
Semi-sitting	1.33 (0.84–2.10)	1.30 (1.00–1.69)
Sitting	0.97 (0.43–2.20)	2.25 (1.37–3.71)
<b>Birthweight (kg)</b>	3.17 (1.91–5.25)	3.98 (2.89–5.49)
<b>Management of the third stage of labour</b>		
Physiological	1.0 (reference)	1.0 (reference)
Active	0.57 (0.37–0.88)	0.59 (0.46–0.76)
<b>Duration of the third stage of labour (minutes)</b>		
≤30	1.0 (reference)	1.0 (reference)
>30	4.14 (2.11–8.19)	2.41 (1.43–4.06)
<b>Parity</b>		
Multipara	1.0 (reference)	1.0 (reference)
Primipara	1.18 (0.70–1.97)	2.30 (1.70–3.11)

\*Variables shown are significantly related to the outcome after controlling for other factors. Other variables included in the analysis were duration of second stage >60 minutes and maternal age (in categories).

In this study, blood loss was measured as opposed to being estimated, which is a common feature in the design of most other studies.<sup>9,12–15</sup> This explains the larger mean blood loss and higher number of women with blood loss greater than 500 ml in our study. It confirms the observation that health professionals underestimate blood loss when the measured amount is more than 300 ml.<sup>28–30</sup> It also corresponds with the finding that almost half of all women who give birth vaginally will lose more than 500 ml of blood if it is measured accurately.<sup>31,32</sup>

In spite of accurate measurements, some underestimation of blood loss may have occurred in women who gave birth in recumbent position and remained lying down during the first hour after birth. Nevertheless, the difference in Hb levels on the fourth to sixth day after delivery and the variation in difference compared with Hb levels at 36 weeks of gestation confirmed a real difference in blood loss between the different study groups.

The increased blood loss in upright positions may be due to various factors. Sitting on the hard surface of a birthing stool or chair may obstruct venous return and therefore lead to an increase in blood loss from perineal damage.<sup>33</sup> On the other hand, upright positions might cause increased hydrostatic pressure both on the arterial and venous side which could contribute to increased bleeding from the uterus and placental site.<sup>9</sup> It has also been suggested that upright birthing positions may affect the production of prostaglandins that play a role in the placental separation and therefore contribute to uterine atony.<sup>19</sup> Multigravidas with a rapid delivery in an upright position might be particularly at risk of haemorrhage from an atonic uterus.<sup>11</sup>

Our findings support the theory that increased blood loss in sitting positions originates from perineal trauma. Most studies in which increased blood loss was found in upright position compared supine position to position on a birthing chair or birthing stool.<sup>9,11,12,14,19,20</sup> Several authors have noted an increase in oedema in these positions which might be due to obstructed venous return.<sup>9,12,34</sup> The oedema may lead to increased blood loss when perineal damage occurs.

Only one study found a higher mean total blood loss after delivery on a birthing chair, even within the group of women with an intact perineum.<sup>9</sup> Blood loss was estimated in this study, and hence measurement bias may therefore explain this finding. In addition, oxytocin infusion and epidural anaesthesia were used in this study and some women also had instrumental deliveries. Further studies are needed to clarify whether upright position leads to increased blood loss when these risk factors are present, even if the perineum is intact.

Studies involving a nonsitting upright position, such as squatting, found no difference in blood loss between upright and supine position.<sup>7,17,35,36</sup> In this position, venous return from the perineum is not obstructed. Gardosi *et al.*<sup>18</sup> found that a modified squatting position on a birth cushion, which



gives way when a woman is bearing down, did not increase blood loss compared with supine position. We found a linear association between a more sitting position (recumbent, semi-sitting and sitting) and an increased risk of blood loss in the subgroup of women with perineal damage but not among women with an intact perineum. This indicates that venous obstruction caused by the birthing stool or hard mattress caused the increase in blood loss.

Obstruction in venous return may be prevented by alternating positions during the second stage of labour. In addition, positions could be used in which venous return is not obstructed, such as squatting, lateral and hands-and-knees positions.

The incidence of perineal damage did not differ between position groups. Thirty-one women had a third or fourth degree tear, and the incidence did not differ between the groups ( $P = 0.656$ ). Lithotomy, sitting, standing and squatting positions have all found to be associated with an increase in third degree tears, although the differences with the control group were not always significant because of the low number of women with this complication.<sup>17,37–43</sup> Other studies have not confirmed these findings,<sup>7,36</sup> and some showed less perineal trauma in sitting, semi-sitting, hands-and-knees or kneeling positions.<sup>44–47</sup> The association between birthing positions and severe perineal trauma is still unclear and is not a reason for restricting women's choice of birthing position.<sup>17,33,47</sup>

In our study, perineal damage was independently associated with blood loss greater than 500 ml. A policy of restricted rather than routine use of episiotomy leads to less perineal damage.<sup>48</sup> Regardless of the birthing position, restricting the use of an episiotomy to medical indications may reduce the number of women with severe blood loss.

There are some limitations in this study. First, a common problem in studies examining different birthing positions is that the distinction between the various positions is not always clear-cut.<sup>49</sup> Some misclassifications, especially between recumbent and semi-sitting position, might have decreased the observed differences. Nevertheless, significant differences were found between these two groups.

Second, the midwives and the study population may not have been entirely representative for the whole country. The sample of midwifery practices was self-selected based on their willingness to participate. However, the selection was not based on midwives' attitudes towards birthing positions, and position was only registered as a possible confounder in the trial. Therefore, selection bias was unlikely to influence the measurement of blood loss in the various birthing positions.

The exclusion of women who were unable to read the Dutch language resulted in a very small number of women of non-Dutch origin in the sample. It is therefore unclear to which extent our results apply to ethnic minority populations in the Netherlands.

Third, the data were collected a decade ago. The characteristics of women and midwifery management may have

changed since then. Even so, we have no reason to believe that practices with regard to birthing positions and management of the third stage of labour have changed significantly during this time period. The findings on the relationship between birthing position, perineal damage and blood loss are still relevant today.

Although postpartum haemorrhage is defined by the WHO as blood loss greater than 500 ml, healthy women can tolerate at least twice this amount without serious consequences.<sup>21,31</sup> It is reassuring that the increased blood loss found in upright birthing positions is unlikely to be of uterine origin, as this can lead to excessive amounts of blood loss in a very short time.

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